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# *A Method for* ESTIMATING THE MONEY VALUE OF CORN SILAGE

By W. B. Nevens, K. E. Harshbarger,
R. W. Touchberry, G. H. Dungan

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# A Method for Estimating the Money Value of Corn Silage

By W. B. Nevens, K. E. Harshbarger, R. W. Touchberry, and G. H. Dungan[1]

A METHOD OF FIGURING the money value of corn silage is frequently needed to provide a basis for settling accounts between landlord and tenant, for farm-management cost-accounting records, for computing the farm cost of production of animal products, and for making economic interpretations of the results of feeding experiments. Since not enough silage is sold each year to establish a normal market price, some empirical method for determining a monetary value is needed.

The money value of a ton of corn silage may be calculated in a number of ways. The principal methods of arriving at this value usually follow one of four lines, namely: (1) the net value of the meat or milk produced from feeding the silage; (2) the cost of production of the forage plus the cost of ensiling and storing as silage; (3) the money value of nutrients in hay applied to the amount of nutrients in silage; and (4) an arbitrary fractional value, such as one-third to two-fifths, of the market price of hay.

The values obtained by applying two or more of these methods to the same lot of silage may differ considerably. It is necessary for the user to determine which method is the most suitable for a particular lot of silage. Furthermore the results of feeding tests conducted in one year may not agree with those obtained in another year. One of the common reasons for disagreement is the variable character of corn forage at the time of harvest for the silo. It is well known that the amount of grain in corn forage at the early silage stage is relatively small in comparison with that in the forage at a well-advanced stage. The amounts of the total digestible nutrients in silage tend to increase with advancing development and increasing dry-matter content of the forage. On the other hand, the operational costs of growing, harvesting, and storing corn forage as silage are affected but little by stage of development.

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The purposes of this publication are: (1) to explain the principal cause for variability in the feeding value of different lots of corn silage, and (2) to present a simple method for calculating the money value of corn silage. The findings are based on a five-year trial in which corn forage harvested at pre-silage, early-silage, good-silage, and late-silage stages was separated into ear and leaf-stalk fractions and the amounts of each fraction measured. These data are more extensive than those heretofore published.

## PREVIOUS INVESTIGATIONS

The Illinois Station has published several reports on methods of arriving at the value of corn silage. Whisenand reported that the grain content of silage at the Station during the years 1910 to 1914 ranged from 3.7 to 7.3 bushels per ton.[1] His method of estimating the value of a ton of silage took into account the cost of harvest and storage, including such miscellaneous items as building cost and insurance, to which was added the farm value of the grain and stover. The total of these costs was increased by one-fifth to allow for an estimated one-sixth loss in weight caused by fermentation and drying.

Pearson and Gaines proposed two methods of estimating the money value of corn silage.[2] Their cost-accounting method was based on a summary of detailed cost accounts on 68 farms during the years 1912 to 1916. On these farms there were harvested for silage 1,725 acres of corn having an acre yield of 5.71 tons of "silage" containing 28 bushels of corn, or 4.6 bushels per ton. The grain value formed 60.5 percent and the stalk (stover) values formed 4.8 percent of the total worth of the silage. The remaining values were made up of harvesting and buildings costs.

The second method was based upon estimates of the nutritive value of the grain and nongrain portions of the silage. The amount of crop was determined by weighing at time of harvest for the silo, and the grain portion of the forage was estimated from a few representative rows of the crop left in the field for harvest of fully ripened ears. The average number of pounds of total digestible nutrients in a ton of silage minus the number of pounds of total digestible nutrients in the ears was assumed to represent the nutrient content of the leaf-stalk portion. The dollar value of the leaf-stalk portion was estimated

[1] Whisenand, J. W. Factors in the cost of corn silage. Amer. Soc. Anim. Prod. Proc., 87-92. 1919.

[2] Pearson, F. A., and Gaines, W. L. The evaluation of corn silage. Amer. Soc. Agron. Jour. 16, 251-260. 1924.

from the market value of the number of pounds of grass hay needed to furnish the quantity of total digestible nutrients in the leaf-stalk portion. The authors, however, called attention to the highly variable grain content of silage and stated that most satisfactory results are obtained only when the amounts of grain and stalks are determined separately for each lot of silage.

A method published in Illinois Circular 686[1] was based upon the amounts of ears, stalks, and leaves as determined from field samples of corn forage taken immediately before harvest for silage. The yearly mean values for air-dry ears per ton of fresh forage ranged from 3.1 bushels to 5.3 bushels, while the air-dry stalks and leaves per ton ranged from 340 to 420 pounds (ears, stalks, and leaves were calculated to a 15-percent moisture basis). The mean values for the seven-year period were 4.0 bushels of ears and 375 pounds of stalks and leaves. This quantity of stalks and leaves was estimated to be equivalent in feeding value to 340 pounds of hay.

## PRESENT INVESTIGATION

The report here given covers only two of the factors involved in the evaluation of corn silage: the ear content and the leaf-stalk content of the forage at stages of development at which the crop might be harvested for silage. By determining the dry-matter content of the forage at the time of harvest and using the estimates given in Table 2 along with current hay and corn prices, it is possible to calculate the monetary value of silage. In the absence of dry-matter determinations at harvest time, the same procedure may be used in estimating the dry-matter and ear contents of well-preserved corn silage, provided the crop was ensiled at a stage such that no seepage occurred and provided no water was added. Obviously, if water is added at the time of ensiling or if seepage occurs, the dry-matter content of the silage would be changed.

### Experimental Procedure

The data upon which this report is based were obtained from the forage of hybrid corn grown for silage on the Dairy Science farm of this Station. The hybrids had been shown by previous tests (reported in Illinois Bulletins 494 and 533) to be high yielding and suitable for either grain or silage when grown at Urbana. The hybrids employed in this experiment were: Illinois Hybrids 206, 784, 972A-1, and

[1] Nevens, W. B. Making high quality silage for dairy cattle. Ill. Agr. Ext. Cir. 686. 1951.

2119(W), and U. S. Hybrid 13. In this report, these are known as Numbers 1, 2, 3, 4, and 5, respectively. These hybrids were grown in each of five years, 1947-1951, in a randomized order in a series of eight blocks. Each block was 247 feet long and 67 feet wide (approximately 0.4 acre) and contained four rows of each of the five entries. The seed was drilled in rows spaced 40 inches apart. The plants were spaced from 12 to 16 inches apart in the row (the average for most plots falling within the range of 13 to 15 inches), giving a population of 9,000 to 10,000 to the acre. There was practically no lodging of the plants and but little insect injury.

The acre yields and the proportions of ears and mixed stalks and leaves were determined from samples of the standing forage. The first sampling, consisting of 20 to 30 plants of each hybrid, was made when the kernels were in the early milk stage. Subsequent samples were taken at approximately weekly intervals up to the time of complete harvest of the crop for silage.

The samples were taken as soon as possible to the field laboratory where they were weighed and each plant was separated into ear and leaf-stalk portions. The ears were hung on racks for air-drying, and the leaf-stalk portion was chopped in a power cutter and subsampled. Subsamples were dried in an oven. The dry-matter yields of ears and leaf-stalk portion of the forage were calculated from these determinations. The yields shown in Table 1 are averages of the eight plots of each of the five hybrids at each sampling date.

## General Characteristics of the Crops

In each season the first one or two sampling harvests were made at a time when the corn was not far enough advanced in growth to make good-quality silage. The last sampling occurred when the crop had reached a suitable stage of development to make silage having both good keeping qualities and high feeding value. Studies at this Station indicate that the most satisfactory stage at which to harvest corn for silage is when the dry-matter content ranges from 25 to 30 percent.

The yields of fresh forage were high, ranging from 10 to 20 tons to the acre. In 1947 and 1950 the fresh-forage yields remained about the same at each of the weekly sampling dates, while in 1948 and 1949 the yields generally declined from one week to the next. In all five seasons, however, successive harvests showed a continuous and rapid increase in the dry-matter yields.

The yields of dry matter varied considerably from season to season but were considered to be high, ranging from slightly less than 3 tons to more than 5 tons to the acre, at the last harvest of the season. According to reports of the U. S. Department of Agriculture, yields of corn silage in Illinois for the years 1947 to 1951 ranged from 7.4 to 11.5 tons. Such yields of fresh forage would presumably furnish from 2 to 3.5 tons of dry matter to the acre.

The weight of the dry matter contained in the leaf-stalk portion of a ton of fresh forage increased but little, if any, with advancing development of the crop. This was in great contrast to the change in the ear portion.

The most striking phenomenon disclosed by this study is the rapid increase in the ear portion of the dry matter of the crop with advancing development. In all five seasons covered by the study, each of the five hybrids showed an increase each week in the ear portion of the dry matter. At the time of the first sampling, about 11 percent of the dry matter of the 1947 crop was in the ear portion. At the last sampling, 25 days later, this had risen to 48 percent (Table 1).

The proportion of ears in the forage is best shown by calculating the weight of ears in a ton of fresh forage as harvested for silage. When the first samples were taken, the 1947 crop yielded 490 pounds of ears (7 bushels) to the acre, but in a little more than three-weeks' time the yield had risen to 3,300 pounds, or 49 bushels. In 1948 four of the hybrids yielded about 25 bushels (1,750 pounds) to the acre at the first sampling and more than 100 bushels (7,000 pounds) at the final sampling date, 22 days later (Table 1). Although the other hybrid, Number 4, is a good producer of grain, it is a little later in maturity and for this reason was lower than the other hybrids in percentage of dry matter and in yield of ears at the various sampling dates. The data clearly illustrate the rapid development of ears during the latter part of the growing season.

In each of the five seasons, the quantity of ears in the forage at the time of taking the first samples was small, being less than 2 bushels in a ton of fresh forage, with two exceptions. As was true for yield of ears to the acre, the ears in a ton of forage also increased at each subsequent sampling date. At the last sampling date in 1948, three of the hybrids showed an ear content of 6 bushels or more in a ton of forage (Table 1).

In an earlier investigation at this Station in which ten corn hybrids, each grown in six replications, were harvested at a stage suitable for fodder (when the dry-matter content of the forage ranged from 38 to

## Table 1. — Yields of Corn Forage Grown for Silage and Amounts of Ears and Leaf-Stalk Portion in a Ton of Forage

| Date of sampling | Hybrid | Forage | | | Leaves and stalks in 1 ton of fresh forage[a] | Ears | | |
|---|---|---|---|---|---|---|---|---|
| | | Fresh matter per acre | Dry-matter content | Dry matter per acre | | Part of forage formed by ears[b] | Yield per acre[c] | In 1 ton of fresh forage[c] |
| **1947** | | | | | | | | |
| | | *tons* | *perct.* | *tons* | *lb.* | *perct.* | *bu.* | *bu.* |
| Aug. 28 | 1 | 10.02 | 16.8 | 1.69 | 347 | 12.3 | 7.0 | 0.7 |
| | 2 | 11.38 | 17.3 | 1.97 | 365 | 10.3 | 6.7 | 0.6 |
| | 3 | 10.27 | 18.6 | 1.91 | 379 | 13.4 | 8.6 | 0.8 |
| | 4 | 10.23 | 16.8 | 1.72 | 362 | 8.4 | 4.9 | 0.5 |
| | 5 | 10.25 | 17.4 | 1.78 | 357 | 12.8 | 7.7 | 0.8 |
| Sept. 4 | 1 | 9.98 | 19.5 | 1.95 | 331 | 27.8 | 18.2 | 1.8 |
| | 2 | 11.24 | 19.8 | 2.23 | 354 | 24.1 | 18.0 | 1.6 |
| | 3 | 10.00 | 20.2 | 2.02 | 334 | 29.8 | 20.2 | 2.0 |
| | 4 | 9.76 | 18.7 | 1.83 | 353 | 19.8 | 12.2 | 1.2 |
| | 5 | 10.26 | 19.6 | 2.01 | 333 | 27.8 | 18.8 | 1.8 |
| Sept. 15 | 1 | 10.21 | 25.1 | 2.56 | 332 | 43.8 | 37.7 | 3.7 |
| | 2 | 11.61 | 24.8 | 2.88 | 356 | 39.0 | 37.7 | 3.2 |
| | 3 | 10.49 | 26.9 | 2.82 | 342 | 46.0 | 43.6 | 4.2 |
| | 4 | 10.20 | 24.2 | 2.47 | 371 | 34.9 | 29.0 | 2.8 |
| | 5 | 11.01 | 25.1 | 2.76 | 334 | 43.4 | 40.3 | 3.7 |
| Sept. 22 | 1 | 10.27 | 28.0 | 2.87 | 323 | 51.0 | 49.3 | 4.8 |
| | 2 | 11.46 | 27.6 | 3.16 | 342 | 47.4 | 50.4 | 4.4 |
| | 3 | 10.12 | 29.0 | 2.93 | 330 | 51.7 | 51.0 | 5.0 |
| | 4 | 10.13 | 26.6 | 2.69 | 368 | 41.2 | 37.3 | 3.7 |
| | 5 | 10.65 | 27.2 | 2.90 | 319 | 50.2 | 58.1 | 5.5 |
| **1948** | | | | | | | | |
| Aug. 16 | 1 | 20.06 | 17.2 | 3.45 | 299 | 26.2 | 30.4 | 1.5 |
| | 2 | 20.20 | 16.5 | 3.33 | 316 | 18.5 | 20.7 | 1.0 |
| | 3 | 18.95 | 17.9 | 3.39 | 312 | 25.9 | 29.5 | 1.6 |
| | 4 | 17.78 | 15.5 | 2.76 | 310 | 15.1 | 14.0 | 0.8 |
| | 5 | 17.97 | 17.7 | 3.54 | 304 | 27.0 | 32.1 | 1.6 |
| Aug. 24 | 1 | 20.38 | 22.4 | 4.57 | 312 | 40.8 | 62.6 | 3.1 |
| | 2 | 20.99 | 21.1 | 4.43 | 329 | 33.7 | 50.2 | 2.4 |
| | 3 | 18.86 | 23.3 | 4.40 | 323 | 41.1 | 60.7 | 3.2 |
| | 4 | 15.51 | 21.8 | 3.38 | 358 | 30.2 | 34.3 | 2.2 |
| | 5 | 18.16 | 22.5 | 4.09 | 327 | 38.3 | 52.6 | 2.9 |
| Aug. 31 | 1 | 18.43 | 26.5 | 4.88 | 318 | 49.0 | 80.4 | 4.4 |
| | 2 | 19.68 | 25.6 | 5.04 | 323 | 46.3 | 78.4 | 4.0 |
| | 3 | 17.93 | 27.9 | 5.00 | 316 | 51.9 | 87.3 | 4.9 |
| | 4 | 18.00 | 24.1 | 4.34 | 325 | 42.7 | 62.3 | 3.5 |
| | 5 | 18.01 | 26.1 | 4.70 | 305 | 50.4 | 79.6 | 4.4 |
| Sept. 7 | 1 | 18.01 | 31.8 | 5.73 | 330 | 55.9 | 107.6 | 6.0 |
| | 2 | 18.35 | 31.0 | 5.69 | 338 | 53.7 | 102.7 | 5.6 |
| | 3 | 16.90 | 33.9 | 5.73 | 333 | 58.3 | 112.3 | 6.6 |
| | 4 | 15.07 | 29.1 | 4.39 | 348 | 49.2 | 72.5 | 4.8 |
| | 5 | 16.85 | 31.2 | 5.26 | 313 | 57.3 | 101.2 | 6.0 |
| **1949** | | | | | | | | |
| Aug. 16 | 1 | 17.40 | 20.1 | 3.50 | 342 | 27.6 | 32.5 | 1.9 |
| | 2 | 18.82 | 20.1 | 3.78 | 367 | 22.5 | 28.6 | 1.5 |
| | 3 | 18.23 | 20.9 | 3.81 | 355 | 27.9 | 35.7 | 2.0 |
| | 4 | 19.49 | 19.0 | 3.70 | 360 | 19.4 | 24.2 | 1.2 |
| | 5 | 18.12 | 20.4 | 3.70 | 331 | 31.0 | 38.5 | 2.1 |
| Aug. 23 | 1 | 16.61 | 23.8 | 3.95 | 356 | 36.4 | 48.4 | 2.9 |
| | 2 | 17.88 | 22.7 | 4.06 | 366 | 31.4 | 42.8 | 2.4 |
| | 3 | 16.29 | 24.1 | 3.93 | 358 | 37.0 | 48.8 | 3.0 |
| | 4 | 17.92 | 21.8 | 3.91 | 374 | 27.1 | 35.6 | 2.0 |
| | 5 | 17.81 | 23.8 | 4.24 | 340 | 39.2 | 55.8 | 3.1 |
| Aug. 30 | 1 | 16.91 | 27.1 | 4.58 | 360 | 43.6 | 67.2 | 4.0 |
| | 2 | 16.90 | 26.8 | 4.53 | 385 | 39.0 | 59.4 | 3.5 |
| | 3 | 16.41 | 28.8 | 4.73 | 371 | 45.3 | 72.0 | 4.4 |
| | 4 | 18.62 | 25.0 | 4.65 | 382 | 35.1 | 54.9 | 2.9 |
| | 5 | 15.64 | 31.0 | 4.85 | 395 | 45.9 | 74.8 | 4.8 |

[a] In terms of stalks and leaves containing 15 percent moisture. [b] Dry-matter basis.
[c] In terms of ears containing 15 percent moisture, 70 pounds of ears to the bushel.

Table 1. — (Concluded)

| Date of sampling | Hybrid | Forage | | | Leaves and stalks in 1 ton of fresh forage[a] | Ears | | |
|---|---|---|---|---|---|---|---|---|
| | | Fresh matter per acre | Dry-matter content | Dry matter per acre | | Part of forage formed by ears[b] | Yield per acre[c] | In 1 ton of fresh forage[c] |
| | | **1950** | | | | | | |
| | | *tons* | *perct.* | *tons* | *lb.* | *perct.* | *bu.* | *bu.* |
| Aug. 22 | 1 | 13.71 | 19.3 | 2.65 | 356 | 21.6 | 19.2 | 1.4 |
| | 2 | 13.87 | 18.7 | 2.59 | 375 | 14.8 | 12.9 | 0.9 |
| | 3 | 12.17 | 20.0 | 2.43 | 373 | 20.8 | 17.0 | 1.4 |
| | 4 | 13.47 | 19.1 | 2.57 | 403 | 10.4 | 9.0 | 0.7 |
| | 5 | 12.48 | 20.4 | 2.55 | 375 | 21.8 | 18.7 | 1.5 |
| Aug. 29 | 1 | 13.44 | 21.8 | 2.93 | 346 | 32.5 | 32.0 | 2.4 |
| | 2 | 14.67 | 21.6 | 3.17 | 363 | 28.5 | 30.4 | 2.1 |
| | 3 | 12.62 | 23.5 | 2.96 | 371 | 32.9 | 32.8 | 2.6 |
| | 4 | 13.64 | 20.9 | 2.85 | 379 | 22.9 | 21.9 | 1.6 |
| | 5 | 12.92 | 19.7 | 2.55 | 361 | 22.2 | 19.0 | 1.5 |
| Sept. 5 | 1 | 13.55 | 24.5 | 3.32 | 336 | 41.7 | 46.5 | 3.4 |
| | 2 | 13.61 | 24.2 | 3.29 | 359 | 36.9 | 40.8 | 3.0 |
| | 3 | 12.75 | 22.4 | 2.86 | 340 | 35.4 | 34.0 | 2.7 |
| | 4 | 14.73 | 23.1 | 3.40 | 368 | 32.3 | 36.9 | 2.5 |
| | 5 | 12.67 | 22.7 | 2.88 | 348 | 34.9 | 33.7 | 2.7 |
| Sept. 12 | 1 | 13.58 | 27.0 | 3.67 | 334 | 47.5 | 58.6 | 4.3 |
| | 2 | 14.46 | 26.4 | 3.82 | 334 | 46.3 | 59.4 | 4.1 |
| | 3 | 12.66 | 26.8 | 3.39 | 330 | 47.6 | 54.3 | 4.3 |
| | 4 | 13.92 | 25.4 | 3.54 | 351 | 41.2 | 49.0 | 3.5 |
| | 5 | 12.68 | 28.2 | 3.58 | 337 | 49.2 | 59.1 | 4.7 |
| | | **1951** | | | | | | |
| Aug. 21 | 1 | 14.68 | 20.5 | 3.01 | 346 | 28.2 | 28.5 | 1.9 |
| | 2 | 16.14 | 20.4 | 3.29 | 384 | 20.0 | 22.1 | 1.4 |
| | 3 | 12.82 | 21.5 | 2.76 | 383 | 24.1 | 22.3 | 1.7 |
| | 4 | 14.12 | 19.6 | 2.77 | 392 | 15.0 | 13.9 | 1.0 |
| | 5 | 14.07 | 20.9 | 2.94 | 356 | 27.6 | 27.3 | 1.9 |
| Aug. 28 | 1 | 15.95 | 20.6 | 3.29 | 315 | 35.0 | 38.7 | 2.4 |
| | 2 | 17.54 | 20.3 | 3.56 | 341 | 28.6 | 34.2 | 1.9 |
| | 3 | 14.73 | 21.6 | 3.18 | 337 | 33.6 | 35.9 | 2.4 |
| | 4 | 15.54 | 19.4 | 3.01 | 360 | 23.2 | 23.5 | 1.5 |
| | 5 | 15.37 | 20.9 | 3.21 | 317 | 35.5 | 38.3 | 2.5 |
| Sept. 4 | 1 | 15.13 | 24.9 | 3.77 | 333 | 43.1 | 54.6 | 3.6 |
| | 2 | 17.40 | 24.9 | 4.33 | 350 | 40.3 | 58.7 | 3.4 |
| | 3 | 14.90 | 25.9 | 3.86 | 341 | 44.0 | 57.1 | 3.8 |
| | 4 | 16.04 | 22.8 | 3.66 | 356 | 33.7 | 41.4 | 2.6 |
| | 5 | 14.76 | 24.8 | 3.66 | 330 | 43.4 | 53.4 | 3.6 |

[a] In terms of stalks and leaves containing 15 percent moisture. [b] Dry-matter basis.
[c] In terms of ears containing 15 percent moisture, 70 pounds of ears to the bushel.

51 percent), the proportion of the dry matter of the crop formed by ears ranged among the hybrids from 47 to 58 percent.[1] Three of the ten hybrids (U. S. 13 and Illinois Hybrids 206 and 784) were identical with the hybrids used in the experiment reported in this bulletin. The findings of the earlier trial support the conclusion that the proportion of the dry matter of corn forage which is comprised of ears continues to increase beyond the silage-harvest stage.

[1] Nevens, W. B., and Dungan, G. H. Yields of corn hybrids harvested for silage and methods to determine the best time to harvest. Ill. Agr. Exp. Sta. Bul. 494. 1942.

## What the Results Mean

The fresh-matter yields of corn forage continued to increase until a maximum was reached and then gradually declined. During the period of decline in fresh weight, there was a rapid build-up of dry matter in ears. The 1948 crop at time of first sampling contained a little over 3 tons of dry matter to the acre, while at the last sampling it showed a dry-matter yield of more than 5 tons.

The condition of the crop must be carefully observed if it is to be harvested for silage at the optimum stage. The first samples were taken when the corn contained too little dry matter (less than 20 percent) to make good silage. The last samples were taken at a good silage stage (25 to 30 percent dry matter), except in 1948, when the forage had advanced a little too far to insure the best keeping qualities of the silage.

Early harvest of the crop means a great sacrifice in the potential feeding value of the crop. As pointed out above, there may be an increase of as much as 2 tons of dry matter to the acre even though the yield of total forage is declining. One of the chief advantages to be gained in harvesting corn forage at the optimum stage of development is the fact that the feeding value of a ton of silage is much greater at that stage than when the crop is too low in dry-matter content or when it is ensiled with so little moisture that it molds.

**How to estimate ear content of forage or silage.** The data obtained in this experiment clearly show a rapid and steady increase in the yield of ears per acre and in the ear content of a ton of forage. Because of the close relationship of dry-matter percentage to the amount of ears, it is possible to estimate from the dry-matter content the approximate number of pounds of ears in a ton of forage. To aid in making such an estimate, regression values based on the field data shown in Table 1 have been calculated. These values, which are shown in Table 2, are dependable measures of the number of bushels of ears, *provided that the dry-matter content of the forage has been carefully determined and provided that attention is given to the limitations of the method,* as discussed below.

The ear and leaf-stalk content of silage that is in a well-preserved condition can also be estimated with reasonable accuracy by determining its dry-matter content and referring to Table 2.

**Limitations of the method.** The yield data presented in this bulletin were obtained from corn hybrids known to be high producers of grain

Table 2. — Ear-Corn Content and Leaf-Stalk Hay-Equivalent in One Ton of Corn Forage at Various Stages of Development

| Dry-matter content of forage[a] | Ears[b] | Leaves and stalks[c] | Dry-matter content of forage[a] | Ears[b] | Leaves and stalks[c] |
|---|---|---|---|---|---|
| *perct.* | *bu.* | *lb.* | *perct.* | *bu.* | *lb.* |
| 15 | 0.2 | 308 | 24 | 3.1 | 312 |
| 16 | 0.5 | 309 | 25 | 3.4 | 312 |
| 17 | 0.8 | 309 | 26 | 3.8 | 313 |
| 18 | 1.1 | 309 | 27 | 4.1 | 313 |
| 19 | 1.5 | 310 | 28 | 4.4 | 314 |
| 20 | 1.8 | 310 | 29 | 4.8 | 314 |
| 21 | 2.1 | 311 | 30 | 5.1 | 315 |
| 22 | 2.5 | 311 | 31 | 5.4 | 315 |
| 23 | 2.8 | 312 | 32 | 5.7 | 315 |

[a] In the absence of dry-matter determinations, dry-matter content of forage may be estimated on the basis of stage of development, as follows:

Ears beginning to form.....15 percent
Kernels forming.....17 percent
Early milk.....20 percent
Late milk.....23 percent
Early dent.....25 percent
Well dented.....28 percent
Kernels hardening, most leaves green...30 percent
Kernels hardening, fewer leaves green...32 percent

[b] On basis of 15 percent moisture, 70 pounds of ears per bushel.

[c] Hay-equivalent value; on basis of 15 percent moisture.

and adapted to the region in which they were grown. The forage was produced on highly productive land. The findings with regard to the ear content of corn forage as given here *may not apply to corn forage produced from late-maturing hybrids or varieties, or to corn forage grown on soils low in fertility.*

Further, it should be expected that the method of estimating the ear content of forage *may not apply to corn forage in which there are numerous barren plants, incompletely filled ears, or broken or stunted plants* caused by such factors as extreme heat, drouth, and insect or disease damage.

It should be remembered also that the method is based on accurate determinations of the dry-matter content of the crop at the time of harvest for silage or of the silage itself. *Estimates made without careful appraisal of the condition of the crop at the time of harvest are likely to be misleading.*

The purpose of the method is only to provide a simple and dependable means of arriving at the money value of silage in terms of the value of an equivalent amount of nutrients in ear corn and grass hay. In no sense should the method be considered a means of arriving at the cost of production of silage. Further, the method does not provide a suitable value to use in comparing returns from harvesting corn as silage or as grain, or in comparing costs and returns in producing a given amount of feed as corn silage or as corn (grain) and hay.

## HOW TO CALCULATE THE MONEY VALUE OF CORN SILAGE

The money value of corn silage may be calculated by applying the market price of ear corn to the estimated number of bushels of ears and the market price of grass hay equivalent to the amount of the leaf-stalk portion of the silage.

**Value of ears.** A dependable estimate of the ear content of forage at the time of filling the silo may be made by determining the dry-matter content of the forage or, in most cases, by determining the dry-matter content of the silage[1] and calculating from Table 2 the number of bushels of ears per ton.

In the absence of a determination of dry matter, an estimate may be made from Table 2 and its footnotes if the stage of development at the time of ensiling is known. In this experiment, sampling was done five times when the dry-matter content for making good silage was optimum, namely, between 25 and 30 percent. The average ear content of the forage for these five determinations was 4.1 bushels (air-dry basis). This is nearly the same as the average value of 4 bushels per ton, which was found for the seven years of silage trials at this Station immediately preceding the experiment here reported. A figure of 4 bushels per ton, therefore, is a fair estimate for the ear content of high-producing grain types of silage corn grown under conditions similar to those of central Illinois.

**Value of leaf-stalk portion of silage.** The leaves and stalks of corn silage have a feed value which is slightly less than that of good-quality grass hay, assuming of course that both feeds are considered on the same dry-matter basis. A convenient method, therefore, is to apply to this portion of the silage the current market price for grass hay, after reducing the weight of the leaf-stalk fraction to its hay equivalent. Since the leaves and stalks are estimated to have about 90

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[1] **How to find the dry-matter content of standing corn.** Harvest 6 to 8 representative plants with a corn knife. Remove to a shady place. Split the stalks lengthwise and cut the plants into pieces not more than 1 to 1½ inches long.

Mix thoroughly and take a sample weighing not more than 4 to 5 pounds. Weigh to ⅒ pound on a milk scale or kitchen scale.

Dry in the oven of the kitchen range. For the first hour keep the temperature at 250° F. After the first hour keep the temperature at 225° F.

Stir occasionally. Continue to dry, preferably overnight, until after several weighings there is no further loss in weight.

To get the percent of dry matter, multiply the dry weight by 100 and divide by the fresh weight.

**Dry-matter content of silage** may be found by following the same procedure, except for the harvesting of representative plants.

## Table 3. — Value of Ear Corn in One Ton of Silage When Market Price of Corn Falls Within Range of $.50 to $2.00

| Dry-matter content of silage | Value when market price of ear corn per bushel is— | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $ .50 | $ .60 | $ .70 | $ .80 | $ .90 | $1.00 | $1.10 | $1.20 | $1.30 | $1.40 | $1.50 | $1.60 | $1.70 | $1.80 | $1.90 | $2.00 |
| *perct.* | | | | | | | | | | | | | | | | |
| 15 | $ .10 | $ .12 | $ .14 | $ .16 | $ .18 | $ .20 | $ .22 | $ .24 | $ .26 | $ .28 | $ .30 | $ .32 | $ .34 | $ .36 | $ .38 | $ .40 |
| 16 | .25 | .30 | .35 | .40 | .45 | .50 | .55 | .60 | .65 | .70 | .75 | .80 | .85 | .90 | .95 | 1.00 |
| 17 | .40 | .48 | .56 | .64 | .72 | .80 | .88 | .96 | 1.04 | 1.12 | 1.20 | 1.28 | 1.36 | 1.44 | 1.52 | 1.60 |
| 18 | .55 | .66 | .77 | .88 | .99 | 1.10 | 1.21 | 1.32 | 1.43 | 1.54 | 1.65 | 1.76 | 1.87 | 1.98 | 2.09 | 2.20 |
| 19 | .75 | .90 | 1.05 | 1.20 | 1.35 | 1.50 | 1.65 | 1.80 | 1.95 | 2.10 | 2.25 | 2.40 | 2.55 | 2.70 | 2.85 | 3.00 |
| 20 | .90 | 1.08 | 1.26 | 1.44 | 1.62 | 1.80 | 1.98 | 2.16 | 2.34 | 2.52 | 2.70 | 2.88 | 3.06 | 3.24 | 3.42 | 3.60 |
| 21 | 1.05 | 1.26 | 1.47 | 1.68 | 1.89 | 2.10 | 2.31 | 2.52 | 2.73 | 2.94 | 3.15 | 3.36 | 3.57 | 3.78 | 3.99 | 4.20 |
| 22 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 | 2.75 | 3.00 | 3.25 | 3.50 | 3.75 | 4.00 | 4.25 | 4.50 | 4.75 | 5.00 |
| 23 | 1.40 | 1.68 | 1.96 | 2.24 | 2.52 | 2.80 | 3.08 | 3.36 | 3.64 | 3.92 | 4.20 | 4.48 | 4.76 | 5.04 | 5.32 | 5.60 |
| 24 | 1.55 | 1.86 | 2.17 | 2.48 | 2.79 | 3.10 | 3.41 | 3.72 | 4.03 | 4.34 | 4.65 | 4.96 | 5.27 | 5.58 | 5.89 | 6.20 |
| 25 | 1.70 | 2.04 | 2.38 | 2.72 | 3.06 | 3.40 | 3.74 | 4.08 | 4.42 | 4.76 | 5.10 | 5.44 | 5.78 | 6.12 | 6.46 | 6.80 |
| 26 | 1.90 | 2.28 | 2.66 | 3.04 | 3.42 | 3.80 | 4.18 | 4.56 | 4.94 | 5.32 | 5.70 | 6.08 | 6.46 | 6.84 | 7.22 | 7.60 |
| 27 | 2.05 | 2.46 | 2.87 | 3.28 | 3.69 | 4.10 | 4.51 | 4.92 | 5.33 | 5.74 | 6.15 | 6.56 | 6.97 | 7.38 | 7.79 | 8.20 |
| 28 | 2.20 | 2.64 | 3.08 | 3.52 | 3.96 | 4.40 | 4.84 | 5.28 | 5.72 | 6.16 | 6.60 | 7.04 | 7.48 | 7.92 | 8.36 | 8.80 |
| 29 | 2.40 | 2.88 | 3.36 | 3.84 | 4.32 | 4.80 | 5.28 | 5.76 | 6.24 | 6.72 | 7.20 | 7.68 | 8.16 | 8.64 | 9.12 | 9.60 |
| 30 | 2.55 | 3.06 | 3.57 | 4.08 | 4.59 | 5.10 | 5.61 | 6.12 | 6.63 | 7.14 | 7.65 | 8.16 | 8.67 | 9.18 | 9.69 | 10.20 |
| 31 | 2.70 | 3.24 | 3.78 | 4.32 | 4.86 | 5.40 | 5.94 | 6.48 | 7.02 | 7.56 | 8.10 | 8.64 | 9.18 | 9.72 | 10.26 | 10.80 |
| 32 | 2.85 | 3.42 | 3.99 | 4.56 | 5.13 | 5.70 | 6.27 | 6.84 | 7.41 | 7.98 | 8.55 | 9.12 | 9.69 | 10.26 | 10.83 | 11.40 |

## Table 4. — Value of Leaf-Stalk Hay-Equivalent in One Ton of Silage When Market Price of Hay Falls Within Range of $10 to $44 a Ton

| Dry-matter content of silage | Value when market price of hay per ton is— | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $10 | $12 | $14 | $16 | $18 | $20 | $22 | $24 | $26 | $28 | $30 | $32 | $34 | $36 | $38 | $40 | $42 | $44 |
| *perct.* | | | | | | | | | | | | | | | | | | |
| 15 | $1.54 | $1.85 | $2.16 | $2.46 | $2.77 | $3.08 | $3.39 | $3.70 | $4.00 | $4.31 | $4.62 | $4.93 | $5.24 | $5.54 | $5.85 | $6.16 | $6.47 | $6.78 |
| 16 | 1.54 | 1.85 | 2.16 | 2.47 | 2.78 | 3.09 | 3.40 | 3.71 | 4.02 | 4.33 | 4.64 | 4.94 | 5.25 | 5.56 | 5.87 | 6.18 | 6.49 | 6.80 |
| 17 | 1.54 | 1.85 | 2.16 | 2.47 | 2.78 | 3.09 | 3.40 | 3.71 | 4.02 | 4.33 | 4.64 | 4.94 | 5.25 | 5.56 | 5.87 | 6.18 | 6.49 | 6.80 |
| 18 | 1.54 | 1.85 | 2.16 | 2.47 | 2.78 | 3.09 | 3.40 | 3.71 | 4.02 | 4.33 | 4.64 | 4.94 | 5.25 | 5.56 | 5.87 | 6.18 | 6.49 | 6.80 |
| 19 | 1.55 | 1.86 | 2.17 | 2.48 | 2.79 | 3.10 | 3.41 | 3.72 | 4.03 | 4.34 | 4.65 | 4.96 | 5.27 | 5.58 | 5.89 | 6.20 | 6.51 | 6.82 |
| 20 | 1.55 | 1.86 | 2.17 | 2.48 | 2.79 | 3.10 | 3.41 | 3.72 | 4.03 | 4.34 | 4.65 | 4.96 | 5.27 | 5.58 | 5.89 | 6.20 | 6.51 | 6.82 |
| 21 | 1.56 | 1.87 | 2.18 | 2.49 | 2.80 | 3.11 | 3.42 | 3.73 | 4.04 | 4.35 | 4.66 | 4.98 | 5.29 | 5.60 | 5.91 | 6.22 | 6.53 | 6.84 |
| 22 | 1.56 | 1.87 | 2.18 | 2.49 | 2.80 | 3.11 | 3.42 | 3.73 | 4.04 | 4.35 | 4.66 | 4.98 | 5.29 | 5.60 | 5.91 | 6.22 | 6.53 | 6.84 |
| 23 | 1.56 | 1.87 | 2.18 | 2.50 | 2.81 | 3.12 | 3.43 | 3.74 | 4.06 | 4.37 | 4.68 | 4.99 | 5.30 | 5.62 | 5.93 | 6.24 | 6.55 | 6.86 |
| 24 | 1.56 | 1.87 | 2.18 | 2.50 | 2.81 | 3.12 | 3.43 | 3.74 | 4.06 | 4.37 | 4.68 | 4.99 | 5.30 | 5.62 | 5.93 | 6.24 | 6.55 | 6.86 |
| 25 | 1.56 | 1.87 | 2.18 | 2.50 | 2.81 | 3.12 | 3.43 | 3.74 | 4.06 | 4.37 | 4.68 | 4.99 | 5.30 | 5.62 | 5.93 | 6.24 | 6.55 | 6.86 |
| 26 | 1.56 | 1.88 | 2.19 | 2.50 | 2.82 | 3.13 | 3.44 | 3.76 | 4.07 | 4.38 | 4.70 | 5.01 | 5.32 | 5.63 | 5.95 | 6.26 | 6.57 | 6.89 |
| 27 | 1.56 | 1.88 | 2.19 | 2.50 | 2.82 | 3.13 | 3.44 | 3.76 | 4.07 | 4.38 | 4.70 | 5.01 | 5.32 | 5.63 | 5.95 | 6.26 | 6.57 | 6.89 |
| 28 | 1.57 | 1.88 | 2.20 | 2.51 | 2.83 | 3.14 | 3.45 | 3.77 | 4.08 | 4.40 | 4.71 | 5.02 | 5.34 | 5.65 | 5.97 | 6.28 | 6.59 | 6.91 |
| 29 | 1.57 | 1.88 | 2.20 | 2.51 | 2.83 | 3.14 | 3.45 | 3.77 | 4.08 | 4.40 | 4.71 | 5.02 | 5.34 | 5.65 | 5.97 | 6.28 | 6.59 | 6.91 |
| 30 | 1.58 | 1.89 | 2.20 | 2.52 | 2.84 | 3.15 | 3.46 | 3.78 | 4.10 | 4.41 | 4.72 | 5.04 | 5.36 | 5.67 | 5.98 | 6.30 | 6.62 | 6.93 |
| 31 | 1.58 | 1.89 | 2.20 | 2.52 | 2.84 | 3.15 | 3.46 | 3.78 | 4.10 | 4.41 | 4.72 | 5.04 | 5.36 | 5.67 | 5.98 | 6.30 | 6.62 | 6.93 |
| 32 | 1.58 | 1.89 | 2.20 | 2.52 | 2.84 | 3.15 | 3.46 | 3.78 | 4.10 | 4.41 | 4.72 | 5.04 | 5.36 | 5.67 | 5.98 | 6.30 | 6.62 | 6.93 |

percent as much feed value as good-quality grass hay, the amount must be reduced by 10 percent before applying to it the market price of grass hay.

The leaf-stalk portion of the forage in field samples is given in Table 1 and the calculated average amount, in terms of its hay equivalent, in Table 2.

**Example:** Assume that the dry-matter content of the forage at the time of ensiling is 27 percent. Table 2 shows that a ton of this forage contains 4.1 bushels of ears. The amount of the hay-equivalent of the leaf-stalk portion is 313 pounds. Apply current market prices to these two items. Assume, for example, that corn is $1.50 a bushel and hay $20 a ton (1 cent a pound). Then 4.1 × $1.50 equals $6.15, the value of the ears. The leaf-stalk hay-equivalent value is 313 × $0.01 or $3.13. The total value of the silage is the sum of these two items or $9.28 for a ton.

The value can also be determined by referring to Tables 3 and 4. Table 3 shows that when the market price of corn is $1.50 a bushel, the value of the ear portion of silage containing 27 percent of dry matter is $6.15. Table 4 shows that when the market price of grass hay is $20 a ton, the value of the hay-equivalent of silage having 27 percent of dry matter is $3.13.

## SUMMARY AND CONCLUSIONS

Five corn hybrids were grown for silage each year from 1947 through 1951 on highly productive land. The hybrids were known from previous trials to be good producers of grain and forage. Beginning when the kernels were in an early milk stage and continuing at approximately weekly intervals until an optimum or advanced silage stage had been reached, samples of the standing forage were obtained by field sampling.

The forage samples were separated into ear and leaf-stalk portions, and dry-matter determinations were made on each portion.

The yields of fresh forage ranged from 10 to 20 tons and the yields of dry matter from 3 to 5 tons per acre. The yields of ears ranged from 7 bushels to the acre at an early stage of development to 100 bushels at an advanced silage-harvest stage. The leaf-stalk portion showed less change than the ear portion, ranging from 300 to 400 pounds of air-dry leaves and stalks in a ton of fresh forage.

The rapid increase in the yield of ears from the pre-silage stage to the normal silage stage raises a serious doubt concerning the reli-

ability of estimates of the amount of ears in silage forage as determined from the harvest of fully ripened ears of corn from representative rows left standing in the field. The data obtained in our trials indicate that such estimates are likely to overrate the proportion of ears in the forage at the silage stage.

The finding from this study that has greatest practical application is that the ear content of corn forage at the silage stage is related to the dry-matter content of the forage. With advancing development from the milk stage to the normal silage stage, the yield of ears to the acre and the number of bushels of ears in a ton of forage rapidly increase. Since the increase is related to the dry-matter content of the forage, a method is given whereby the ear content of a ton of forage harvested for silage can be dependably estimated.

A procedure which can be used for calculating the money value of corn silage is presented.

## OTHER ILLINOIS PUBLICATIONS ON SILAGE

The following Illinois publications give information about silage crops, methods of making silage, and feeding value of the silage. They can be obtained on request from the Information Office, College of Agriculture, Urbana, Illinois.

**Grass and Legume Silages for Dairy Cattle.** Circular 605. 20 pages.

**Making High Quality Silage for Dairy Cattle.** Circular 686. 24 pages.

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